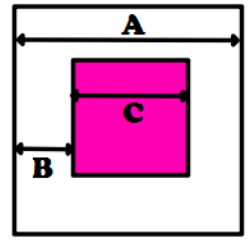
Name ____

Surface Area and Volume



1. Measure the length of each of your agar cubes (A)
    a) Note: You must wear gloves when handling the agar cubes
2. Immerse your 3 pink cubes in vinegar for 10 minutes, gently stirring and turning them periodically
3. While they are soaking, fill in the first data table to compare the surface area, volume, and ratio of surface area to volume of each agar cube
    a) **Show your work** to calculate surface area and volume
    b) Be sure to include **units** for surface area and volume!
    c) Reduce your ratio
4. After 10 minutes, use a spoon to remove the cubes and blot them dry with a paper towel
5. Cut each cube in half and measure the depth to which the vinegar has traveled (no longer pink) and record as diffusion depth (B)
    a) Rinse off the scalpel each time
6. Calculate the diffusion rate for each cube and record in the second data table
7. Determine the extent of diffusion into each cube as a percent of the total volume in the third data table by calculating the following:
    a) Measure one side of the remaining colored portion of each cube (C) and calculate the volume of the colored portion for each cube (C^3)
    b) Determine the volume of the cleared portion of the cubes by subtracting the volume of the colored portion (C^3) from the total volume (A^3)
    c) To calculate the percentage of each cube into which the vinegar diffused, divide the volume of the cleared portion (D) by the total volume (A^3) and multiply by 100
8. Use your data tables to answer the analysis questions

Data Table 1: Surface Area to Volume Ratio

Length of One Side (cm) A	Surface Area (Length x Width x # of sides)		Volume (Length x Width x Height)		Ratio of Surface Area to Volume
	Show Work	Answer (with units)	Show Work	Answer (with units)	
1 cm					
2 cm					
3 cm					

Data Table 2: Rate of Diffusion

Length of One Side (cm) A	Diffusion Depth (cm) B	Time (min)	Diffusion Rate (cm/min)
1 cm			
2 cm			
3 cm			

Data Table 3: Efficiency of Diffusion

Length of One Side (cm) A	Total Volume of Cube (cm^3) (A^3)	Volume of Colored Portion (cm^3) (C^3)	Volume of Clear Portion (cm^3) ($A^3 – C^3 = D$)	Percent of Cube Reached by Diffusion (D / A^3) x 100
1 cm				
2 cm				
3 cm				

Analysis Questions:

1. As the cubes increase in size, what happens to each of the following?
   - The ratio of surface area to volume

   - The rate of diffusion

   - The percent of the cube reached by diffusion

2. In terms of maximizing diffusion, what was the most effective size cube you tested? Why was that size most effective at maximizing diffusion?

3. If each cube represented a living cell and the diffusion medium was a nutrient needed with the cell, what problem might exist for the largest cell?

4. If a large surface area is helpful to cells, why are cells so small? What are the advantages of large organisms being multicellular?

5. Imagine you have three cubes with the following surface area to volume ratios:

- A- 3:1
- B- 5:2
- C- 4:1

Which cube (A, B, or C) is going to be the most effective at maximizing diffusion? EXPLAIN your answer.